Energy and macronutrient intake of a female vegan cyclist during an 8-day mountain bike stage race

Katharina C. Wirnitzer, Dr. rer. nat., and Elmar Kornexl, Univ.-Prof.

This report describes the dietary intake of a vegan mountain biker (height, 161 cm; weight, 49.6 kg; body mass index, 19.1 kg/m^2; relative peak power output, 4.6 W/kg) during the Transalp Challenge 2004 (altitude climbed, 22,500 m; total distance, 662 km), illustrating an aggressive dietary strategy that allowed the cyclist to be competitive. She finished the 8-stage event in 42 hours (mixed category, rank 16; 514 minutes behind the winners of this category), cycling with an average heart rate of 79.5% of laboratory-determined maximum, spending 892 minutes and 1627 minutes at intensities below and above 80%, respectively. During racing, the consumption of energy was 69.3 MJ (1.65 MJ/h), 65.76 MJ from carbohydrates (92 g/h), which was 35% of calories and 40% of carbohydrate total intake, and the fluid ingested was 3 L/day (570 mL/h), 55% of the total fluid consumed.

Mountain bike marathon stage races are very popular, with events such as the Transrockies Challenge attracting thousands of recreational, elite, and professional athletes. Although there are established nutritional guidelines for road cyclists (1, 2), the physiological demands of mountain bike competitions differ markedly from those of road cycling (3, 4), and for this reason the nutritional strategies might differ. Not only are the number of women participating in mountain bike stage events increasing, but probably the number of vegan cyclists is increasing too, given the background numbers of vegans. However, it is difficult to find a group of vegan cyclists participating in the same competition for large sample size studies. Contrary to the belief that the vegan diet is not optimal for athletes, we present the case of a woman who successfully completed a challenging mountain bike stage race while following a vegan diet.

CASE DESCRIPTION

One endurance-trained female amateur mountain biker (age, 30 years; height, 161 cm; weight, 49.6 kg; body mass index, 19.1 kg/m^2; iron, 105 µg/dL [norm: 60–150 µg/dL]; ferritin, 133 ng/mL [norm: 15–150 ng/mL]; hemoglobin, 14 g/dL [norm: 12–16 g/dL]; hematocrit, 41% [norm: 35–49%]; vitamin B12, 280 pg/mL [norm: 200–950 pg/mL]; homocysteine, 7 µmol/L [norm: <14 µmol/L]) was recruited for this case report. She had successfully followed a vegan diet (rejecting all products from animal sources) since 1999 and had 16 years of experience in mountain bike sports, including participating in ultramarathons and stage races. In 2004 she started the Transalp Challenge (TAC) for the second time, having previously completed it in 2003.

TAC is a demanding 8-day race (5) requiring a cyclist to climb a total altitude of 22,500 m and ride a total distance of 662 km. For safety reasons, athletes have to compete in double teams. A total of 1074 professional and amateur mountain bikers participated in the TAC 2004, and winners in all categories were professional mountain bikers. In the TAC 2004, the overall winning team (men's category) finished in 29 hours, 21 minutes, and 9 seconds.

To prepare for this multiday race, the rider trained for about 25 hours per week for almost a year. She performed an incremental laboratory cycling test (started at 100 W, with workload increased by 30 W every 5 min) on an electromagnetically braked ergometer (SRM GmbH, Jülich, Germany) before the start of the event. Relative peak power output (PPO) was 4.6 W/kg. During the race, her heart rate (HR) was continuously recorded, and data were analyzed using software (S710 and 4SW, Polar Electro Oy, Kempele, Finland). The relative intensity of exercise was expressed as percentage of laboratory-determined maximum HR (HR_{MAX}Lab: 182 bpm) and absolute PPO ($PPO_{ABSOLUTE}$Lab: 230 W). After each stage of the race, her body mass was measured and she rated how hard the race was overall, using Borg's rate of perceived exertion (RPE) scale.

The female mountain biker finished in 41 hours, 59 minutes, and 45 seconds, achieving a final ranking of 16th place within the mixed category. Time spent in HR ranges corresponding to <70%, 70%–80%, 80%–90%, and 90%–100% of HR_{MAX}Lab were 314 (± 24) min, 578 (± 50) min, 1350 (± 69) min, and 277 (± 75) min, which is 12.5% (± 7.7%), 22.9% (± 12.2%), 53.6% (± 20.3), and 11.0% (± 25.6%) of total runtime, respectively. The characteristics of the course profile and the exercise intensity details are shown in *Table 1.*

From the Department of Sport Science, Leopold-Franzens University, Innsbruck, Austria.

Corresponding author: Katharina C. Wirnitzer, Dr. rer. nat., Berchat 302/2, A–6135 Stans, Department of Sport Science, Leopold-Franzens University, Fürstenweg 185, A–6020 Innsbruck, Innsbruck, Austria (e-mail: katharina@wirnitzer.at).

Table 1. Characteristics of course profile and exercise intensity during the Transalp Challenge 2004

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Mean ± SD
Temperature (°C)	28	24	24	29	32	33	28	22	28 ± 4
Humidity (relative) (%)	45	45	44	50	45	60	50	94	69 ± 17
Stage distance (km)	80	73	74	119	54	73	124	67	83 ± 25
Stage time (min)	293	328	287	402	225	280	426	278	315 ± 60
Speed (km/h)	16.4 ± 1.2	13.4 ± 1.1	15.5 ± 1.3	17.8 ± 1.6	14.4 ± 1.0	15.6 ± 1.2	17.5 ± 1.9	14.5 ± 0.9	15.6 ± 1.5
$HR_{AVERAGE}$ (beats/min)	164 ± 14	146 ± 15	144 ± 16	143 ± 13	145 ± 17	142 ± 17	139 ± 14	134 ± 18	145 ± 17
$\%HR_{MAX}$Lab	90.1	80.2	79.1	78.6	79.7	78.0	76.4	73.6	79.5 ± 4.8
HR_{MAX} (beats/min)	181	164	164	162	163	162	158	154	164 ± 8
HR_{MAX} ($\%HR_{MAX}$Lab)	99.5	90.1	90.1	89.0	89.6	89.0	86.8	84.6	89.8 ± 4.3
$PO_{AVERAGE}$ (Watt)	208 ± 25	166 ± 26	170 ± 72	165 ± 75	167 ± 29	160 ± 31	151 ± 22	148 ± 28	167 ± 18
$PO_{AVERAGE}$ ($\%PPO_{ABSOLUTE}$Lab)	90.4	72.2	73.9	71.7	72.6	69.6	65.7	64.4	72.6 ± 8.0
PO_{MAX} (Watt)	223	196	193	193	195	193	184	174	194 ± 14
PO_{MAX} ($\%PPO_{ABSOLUTE}$Lab)	97.0	85.2	83.9	83.9	84.8	83.9	80.0	75.7	84.3 ± 6.0
Body mass (kg)	48.2	49.6	48.1	49.2	49.7	49.9	49.9	49.8	49.3 ± 0.8
RPE (6–20) (points)	15	17	19	14	15	17	17	18	16.5 ± 1.7
Uphill cycling									
Total altitude climbed (m)	2398	3099	2619	3366	2103	2732	3995	2141	2807 ± 650
Distance (km)	43.8	43.9	39.7	46.3	23.1	34.7	69.1	14.7	39 ± 16
Downhill cycling									
Total altitude (m)	2512	2556	2770	4030	2333	2633	3264	3234	2917 ± 560
Distance (km)	29.1	26.4	26.8	67.1	27.5	34.6	28.2	34.9	34 ± 14

HR indicates heart rate; PO, power output and PPO, peak PO (both based on laboratory testing); RPE, rate of perceived exertion.

Her dietary plan was based on experience gained in the TAC 2003 and was individually calculated using the current recommendations for cyclists involved in stages races (6, 7). The main goals in preparing the dietary plan were to replace energy, mainly by providing carbohydrates, and to replace fluid needs during daily racing (approximated: energy of 6 MJ, carbohydrates of 70–75 g/h, fluid of 2–4 L). The plan further aimed to meet the athlete's competitive target of placing in the top 20. The complete dietary intake was recorded over the entire period of TAC 2004, using a 24-hour survey with the maximum possible accuracy (daily verification of every nutritional item by both the athlete and team partner). Fluid intake and energy intake were calculated for prerace, race, and postrace periods and subdivided into the macronutrients carbohydrates, protein, and fat. If available, the energy and composition of packed and/or prepared fluid and food were obtained from the manufacturer's declaration. If no food label was available, the calculation of total energy intake and the respective macronutrients for each piece, portion, or dish was determined from the ingredient information and personal communication with the respective chefs (standardized portions) and by using a vegan nutritional information chart and standardized food composition databases (8, 9).

There were no major problems in implementing and conducting the plan. Despite a variety of flavors and good tolerance, over the 8 days the woman gradually became weary of the sweet taste of energy-dense supplements consumed exclusively during racing. She preferred salty, spicy, and savory snacks, foods, and meals (prerace/postrace). Even though she felt permanently satiated, she tried to eat and drink constantly to provide sufficient energy, carbohydrates, and fluid to meet the nutritional requirements and for optimum recovery. Sleeping times were strictly kept in order to maximize recovery.

The results of dietary intake are shown in *Tables 2 and 3* and *Figure 1.* Due to the early start time (8 AM), carbohydrate intake (188 ± 9.8 g/day, 3.8 g/kg) and fluid intake (200 ± 10 mL) were limited at breakfast. During racing, the energy exclusively came from energy-dense supplements, with liquid gels (35.32 ± 1.08 MJ) as the major source of energy (50.9%) and carbohydrates (53.9%). The carbohydrates consumed contributed 40% of overall carbohydrate intake during the TAC 2004. The fluid intake while racing (3 ± 0.8 L/day, 570 mL/h, 12 mL/kg*h) came exclusively from isotonic sport drinks (carbohydrates, 59 g/L; sodium, 350 mg/L), providing 54.7% of total fluid intake (5.5 ± 1.3 L/day), which contributed 29% of energy intake (20.20 ± 0.68 MJ) and 30.6% of carbohydrate

Table 2. Voluntary dietary intake during the Transalp Challenge 2004*

Stage	Time	Foods	Fluids
1	Prerace	1 dark bread, 1 pâté (tin), cereals (with hot water), 2 dried fruits	1 tea
	Race	8 energy gels, 2 energy bars	3 L isotonic sports drink
	Postrace	2 bananas, salad, 3 (big) pasta, 8 sweets	Water (1.8 L)
2	Prerace	4 dark bread, jam	2 tea
	Race	10 energy gels, 2 energy bars	3 L isotonic sports drink
	Postrace	1 banana, salad, 2 (big) pasta, 1 pizza, 16 sweets	Water (1.8 L)
3	Prerace	2 dark bread, 1 roll, jam	2 tea
	Race	12 energy gels, 2 energy bars	3 L isotonic sports drink
	Postrace	1 banana, 2 apricots, 0.5 kg of white bread, roasted potatoes (1 portion), 10 sweets	Water (1 L)
4	Prerace	4 dark bread, cereals (with hot water)	2 tea
	Race	8 energy gels, 2 energy bars	3 L isotonic sports drink
	Postrace	2 bananas, 1 pasta, 1 pizza, 8 sweets	Water (1.5 L)
5	Prerace	3 dark bread, jam	2 tea
	Race	8 energy gels, 2 energy bars	3 L isotonic sports drink
	Postrace	2 bananas, 8 buns, ½ salad, 1 pasta, 1 pizza, 6 sweets	Water (3 L)
6	Prerace	2½ rolls, jam	1 tea
	Race	8 energy gels, 1 energy bar	3 L isotonic sports drink
	Postrace	3 bananas, 4 apricots, 4 buns, 2 pasta, 1 pizza, 8 sweets	Water (2.5 L)
7	Prerace	2 dark bread, jam	2 tea
	Race	14 energy gels, 3 energy bars	4.5 L isotonic sports drink
	Postrace	3 bananas, 4 buns, 4 bruschetta, ½ salad, 2 pizzas, 10 sweets	Water (3 L)
8	Prerace	1 dark bread, 2 rolls, jam, 4 dried fruits	1 tea
	Race	8 energy gels, 1 energy bar	1.5 L isotonic sports drink
	Postrace	4 buns, 2 salads (1 small, 1 big), 1 pasta, 1 pizza, white grapes, 12 sweets	Water (2.5 L), 6 schnapps (jiggers), 5 Prosecco, 4 red wine (glasses)

*Bread (slice); tea (125 mL/cup); pasta (with tomato sauce, portion).

Table 3. Total macronutrient contribution for whole Transalp Challenge 2004 presented as absolute (± SD) and relative values

	g/kg*day	MJ Total ± SD	MJ/day Mean ± SD	% Meal EI	% Total EI
Prerace	4.7	34.24 ± 1.08	4.28 ± 1.80		17.4%
CHO	3.8	25.77 ± 1.35	3.22 ± 0.17	75.3%	
Protein	0.5	3.47 ± 0.22	0.43 ± 0.03	10.1%	
Fat	0.3	5.0 ± 0.36	0.63 ± 0.10	14.6%	
Race	10.2	69.30 ± 1.39	8.66 ± 2.13		35.2%
CHO	9.8	65.76 ± 2.10	8.22 ± 0.25	94.9%	
Protein	0.3	1.79 ± 0.02	0.22 ± 0.01	2.6%	
Fat	0.1	1.75 ± 0.01	0.22 ± 0.01	2.5%	
Postrace	12.9	93.37 ± 1.49	11.67 ± 3.87		47.4%
CHO	10.8	72.57 ± 3.08	9.07 ± 0.39	77.7%	
Protein	1.4	9.41 ± 0.37	1.18 ± 0.05	10.1%	
Fat	0.7	11.39 ± 0.30	1.42 ± 0.08	12.2%	
Total	27.8	196.91 ± 17.03	24.61 ± 3.39		
CHO	24.4	164.11 ± 2.52	20.51 ± 0.32		83.3%
Protein	2.2	14.67 ± 0.28	1.83 ± 0.04		7.5%
Fat	1.2	18.14 ± 0.54	2.27 ± 0.07		9.2%

CHO indicates carbohydrate; EI, energy intake.

intake. Rehydration through water only (2.1 ± 0.7 L/day) was combined with sodium-containing foods plus added salt. Total daily sodium intake was 1402 ± 534 mg, with sport drinks as the major contributor (74.8%).

DISCUSSION

This report describes a woman's nutritional behavior during an 8-day mountain bike race and shows that the athlete was able to implement the planned nutritional strategy. Moreover, the relatively stable body mass indicates that carbohydrate replacement and hydration strategies were adequate. Therefore, a carefully developed and diligently implemented strategy plays a key role in both completing such events and achieving an athlete's goals, but discipline in executing a nutrition plan over consecutive days of racing is another factor.

The high energy intake found during the TAC 2004 can be explained by the characteristics of off-road competitions. In the face of both the environmental conditions and exercise intensity, energy-dense liquids (gels and sport drinks) were important contributors of energy (80.1%), carbohydrates (84.2%), and sodium (99.9%) during racing, allowing the woman to perform better than expected. Her hourly carbohydrate ingestion (1.2 g/kg*h, 92 g/h) was in accordance with current guidelines—1–1.5 g/kg*h (3) or 80–90 g/h (10)—but

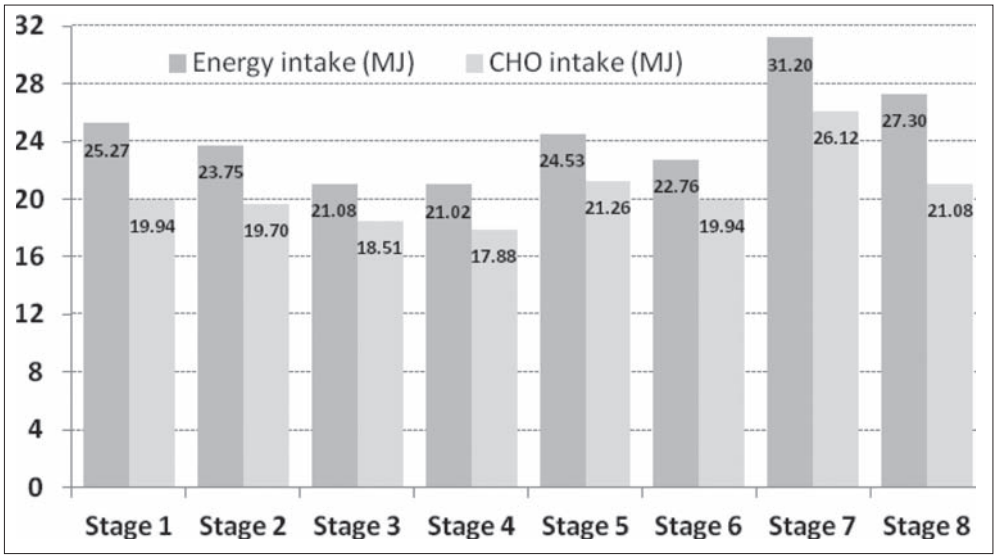

Figure 1. Total energy intake (darker bar) and carbohydrate intake (lighter bar) for each day of the Transalp Challenge 2004.

her carbohydrate intake was twice that recommended for athletes involved in prolonged stage races (≥4–6 h of high intensive cycling: 10–13 g/kg*day) for optimal recovery during 24 hours (1, 2). With an energy intake of 1.65 MJ/h, she further exceeded the hourly recommended energy to be maintained while racing (1 MJ/h) (1).

A study performed on the voluntary food intake of elite female cyclists (11) found that a higher energy intake during a 5-day stage race (14.87 MJ/day) resulted from increased carbohydrate intake (10 g/kg*day). The same was found in our athlete. In line with the considerably lower intakes from energy (17.05 MJ/day, 0.96 MJ/h) and carbohydrates (52.52 g/h) during the TAC 2007 (12), as well as the lower fluid intake normalized to body mass during the TAC 2008 (8.24 mL/kg*h) (13) compared to the current findings, the cyclists completing the TAC 2007 and 2008 were respectively slower (15.3 km/h and 14.4 km/h) than the female mountain biker.

Protein intake was markedly higher than recommended for vegetarian athletes and those involved in multiday ultraendurance events (1.2–1.8 g/kg*day) (10). However, due to the minimal protein provided by the supplements during racing, its percentage to overall calories was lower than anticipated.

There is sufficient evidence from the laboratory and field that an appropriately planned vegan diet can meet recommended levels of dietary needs for a competitive athlete (14). The current results confirm this, and furthermore confirm that a well-planned and implemented vegan diet is compatible with ultraendurance mountain biking. However, given the scarcity of literature on the vegan diet in endurance sports, the nutritional behavior presented highlights the importance of maintaining high carbohydrate levels in meeting the energy demands of such events and can aid the understanding of how to cope with the needs of stage races while following a vegan diet. A nutritional regime like the one described can be useful to athletes who have adopted the vegan diet, as well as to coaches and sport dieticians in developing adequate strategies and designing individualized interventions to meet the nutritional challenges of demanding mountain bike stage races and the requirements of vegan endurance athletes.

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